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FORM PTO-1390 (Modified) (REV 5-93) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 016779-0164

		U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5)
		Unassigned 10/018019
INTERNATIONAL APPLICATION NO. PCT/EP00/05180	INTERNATIONAL FILING DATE June 6, 2000	PRIORITY DATE CLAIMED June 14, 1999

TITLE OF INVENTION
ENHANCING THE LUMINANCE OF LONGTIME LUMINESCENT AND/OR FLUORESCENT SURFACES

APPLICANT(S) FOR DO/EO/US
Juergen WIECZORECK, Adrian SIMMONS, Bianca BLEY and Andreas KOCH

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   - ☒ has been transmitted by the International Bureau.
   - ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   - ☐ have been transmitted by the International Bureau.
   - ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
11. ☐ Applicant claims small entity status under 37 CFR 1.27 .

Items 12. to 17. below concern other document(s) or information included:

12. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
13. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
14. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ Other items or information:

U.S. APPLICATION NO (If known, see 37 C.F.R. 1.5) Unassigned 10/018019	INTERNATIONAL APPLICATION NO. PCT/EP00/05180	ATTORNEY'S DOCKET NUMBER 016779-0164

18. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5): Search Report has been prepared by the EPO or JPO.....$890.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482).....$710.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2) $740.00		
Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37 CFR 1.445(a)(2)) paid to USPTO $1,040.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) $100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$890.00	
Surcharge of $130.00 for furnishing the oath or declaration later than 20 Months from the earliest claimed priority date (37 CFR 1.492(e))	$130.00	

Claims	Number Filed		Included in Basic Fee		Extra Claims		Rate		
Total Claims	20	-	20	=	0	×	$18.00	$0.00	
Independent Claims	2	-	3	=	0	×	$84.00	$0.00	
Multiple dependent claim(s) (if applicable)							$280.00		
TOTAL OF ABOVE CALCULATIONS =								$1020.00	
Reduction by ½ for filing by small entity, if applicable.								$0.00	
SUBTOTAL =								$1020.00	
Processing fee of $130.00 for furnishing English translation later the 20 months from the earliest claimed priority date (37 CFR 1.492(f). +									
TOTAL NATIONAL FEE =								$1020.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +									
TOTAL FEES ENCLOSED =								$1020.00	
							Amount to be: refunded	$	
							charged	$	

a. ☒ A check in the amount of $1020.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 19-0471 in the amount of $1020.00 to the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-0471. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Foley & Lardner
Customer Number: 22428

22428

PATENT TRADEMARK OFFICE

SIGNATURE 34371

NAME Richard L. Schwaab

REGISTRATION NUMBER 25,479

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Attorney Docket No. 016779/0164

In re patent application of

Juergen WIECZORECK et al.

Serial No.: Unassigned

Filed: December 14, 2001

For: ENHANCING THE LUMINANCE OF LONGTIME LUMINESCENT AND/OR FLUORESCENT SURFACES

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified application, Applicants respectfully request that the following amendments be entered into the application:

IN THE TITLE:

Please amend the title on the translation of the application to read the same as is shown on the published application, i.e.:

--ENHANCING THE LUMINANCE OF LONGTIME LUMINESCENT AND/OR FLUORESCENT SURFACES--.

ABSTRACT

Please add the abstract which is attached hereto on a separate page.

IN THE CLAIMS:

Please replace claims 3-8 as entered in the application with the following amended claims:

3. (Amended) The object as claimed in claim 1, characterized in that the interference filter is present in the form of a film or a vapor-deposited layer.

4. (Amended) The object as claimed in claim 1, characterized in that the object has at least the following elements:

a) a backing layer,

b) at least one long-afterglow and/or fluorescent layer arranged over the backing layer, and

c) at least one interference filter arranged over the long-afterglow and/or fluorescent layer.

5. (Amended) The object as claimed in claim 4, wherein the at least one long-afterglow and/or fluorescent layer arranged over the backing layer has at least one luminescent material.

6. (Amended) The object as claimed in claim 4, characterized in that a diffusely reflecting layer is arranged between the backing layer and the at least one long-afterglow and/or fluorescent layer arranged over the backing layer.

7. (Amended) The object as claimed in claim 5, characterized in that the backing layer is diffusely reflecting.

8. (Amended) The use of an object as claimed in claim 1 as a safety marking.

Please add the following new claims:

10. (New) The object as claimed in claim 2, characterized in that the interference filter is present in the form of a film or a vapor-deposited layer.

11. (New) The object as claimed in claim 2, characterized in that the object has at least the following elements:

a) a backing layer,

b) at least one long-afterglow and/or fluorescent layer arranged over the backing layer, and

c) at least one interference filter arranged over the long-afterglow and/or fluorescent layer.

12. (New) The object as claimed in claim 3, characterized in that the object has at least the following elements:

a) a backing layer,

b) at least one long-afterglow and/or fluorescent layer arranged over the backing layer, and

c) at least one interference filter arranged over the long-afterglow and/or fluorescent layer.

13. (New) The object as claimed in claim 5, characterized in that a diffusely reflecting layer is arranged between the backing layer and the at least one long-afterglow and/or fluorescent layer arranged over the backing layer.

14. (New) The object as claimed in claim 6, characterized in that the backing layer is diffusely reflecting.

15. (New) The use of an object as claimed in claim 2 as a safety marking.

16. (New) The use of an object as claimed in claim 3 as a safety marking.

17. (New) The use of an object as claimed in claim 4 as a safety marking.

18. (New) The use of an object as claimed in claim 5 as a safety marking.

19. (New) The use of an object as claimed in claim 6 as a safety marking.

20. (New) The use of an object as claimed in claim 7 as a safety marking.

REMARKS

Applicants respectfully request that the foregoing amendments to Claims 3 through 8 and new claims 10-21 be entered in order to avoid this application incurring a surcharge for the presence of one or more multiple dependent claims. A marked-up version of the claims showing the changes made is attached.

Respectfully submitted,

December 14, 2001
Date

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VERSIONS WITH MARKINGS TO SHOW CHANGES MADE

3. (Amended) The object as claimed in claim 1 [or 2], characterized in that the interference filter is present in the form of a film or a vapor-deposited layer.

4. (Amended) The object as claimed in [one of the preceding claims] claim 1, characterized in that the object has at least the following elements:

a) a backing layer,

b) at least one long-afterglow and/or fluorescent layer arranged over the backing layer, and

c) at least one interference filter arranged over the long-afterglow and/or fluorescent layer.

5. (Amended) The object as claimed in claim [5] 4, wherein the at least one long-afterglow and/or fluorescent layer arranged over the backing layer has at least one luminescent material.

6. (Amended) The object as claimed in claim [5 or 6] 4, characterized in that a diffusely reflecting layer is arranged between the backing layer and the at least one long-afterglow and/or fluorescent layer arranged over the backing layer.

7. (Amended) The object as claimed in [one of claims 5 or 6] claim 5, characterized in that the backing layer is diffusely reflecting.

8. (Amended) The use of an object as claimed in [one of claims 1 to 7] claim 1 as a safety marking.

ABSTRACT

The invention relates to a longtime luminescent and/or fluorescent object emitting a light in an oriented manner and to the utilization of said object as a safety marking. The invention also relates to a method for enhancing the luminance of a longtime luminescent and/or fluorescent object.

Enhancing the luminance of long-afterglow and/or fluorescent surfaces

The present invention relates to long-afterglow and/or fluorescent objects, predominantly long-afterglow and/or fluorescent surfaces, layers or coatings having a high luminance and directional emission of light, to a method for enhancing the luminance of a long-afterglow and/or fluorescent object, and to the use of an object according to the invention as a safety marking.

Long-afterglow and/or fluorescent safety markings are used to mark escape routes and to mark safety-relevant devices on escape routes so that the latter can still be detected even in the case of light failure. The phosphorescence luminance and the size of the phosphorescent surface are decisive for the perceptibility of long-afterglow and/or fluorescent safety markings in the case of sudden failure of energy and absolute darkness. Recently, long-afterglow and/or fluorescent safety markings have been used to a much greater extent in the most varied fields as classic emergency light systems, because of newer developments both as regards phosphorescent luminescent materials, and in the production and the design of long-afterglow and/or fluorescent safety markings which are used in the form of boards, plates, films and shaped pieces. Long-afterglow and/or fluorescent safety markings can be used much more flexibly than classic emergency light systems, both in the general world of work and in public and commercial facilities, buildings, paths, stairways, railroad stations, and on ships or the like which have a high visitor frequency and/or visitor presence. As already indicated, in addition to the surface area the luminance is also decisive for the detectability of a long-afterglow and/or fluorescent safety product. The luminance is influenced by the

quality of the luminescent material, by the fluorescent material coverage, expressed in g/m^2, by the type and color of the background, and the transparency of the medium in which the luminescent material is embedded such as, for example, a coating material or a polymer, as well as on the processing. Moreover, in the particular application the luminance naturally depends very strongly on the existing environmental lighting, that is to say on the illuminant and on the quantity of light. Whereas white or cold white light of luminescent lamps very quickly charges the long-afterglow and/or fluorescent products, warm white or red light is suitable to a much lesser extent. The designations "cold white" and "warm white" are used here in accordance with the standard values for color coordinates and color temperature of the American National Standards Institute (Standard C78.376). Warm white or red light is emitted essentially by incandescent lamps or luminescent lamps of "Warmton" color. However, in conditions of use, that is to say on escape routes and in commercial, industrial and public facilities, it is to be considered that the existing lighting system includes all illuminants, and it is likewise to be considered that the lighting level is very low. It is entirely realistic to assume that a lighting level of 10 Lx ("Lx" corresponds to a unit of the illuminance as a quotient of the light flux and emitting surface) and less obtains in hotels or else in staircase wells.

In order, nevertheless, to be able to use long-afterglow and/or fluorescent markings effectively under such conditions, the long-afterglow and/or fluorescent markings must have a high phosphorescent charging capacity and also a high luminance upon decay of the emission of light. It is to be borne in mind here, above all, that the production costs of a long-afterglow and/or fluorescent marking product are codetermined by the loading of the surface of a marking

with a phosphorescent pigment, which is specified in g/m^2. The higher the loading of the corresponding surface with a selected phosphorescent pigment, the higher also are the production costs of the relevant marking.

It is an object of the present invention substantially to increase the phosphorescent and/or fluorescent luminance of long-afterglow and/or fluorescent markings, in particular of safety markings, in conjunction with an identical luminescent material coverage and also conditions which are otherwise identical, such that the perceptibility of these markings is significantly increased, and therefore the escape route is signalled even more effectively and reliably in dangerous situations to persons escaping.

This object is achieved by means of an object as claimed in claim 1 and a method as claimed in claim 10. Further possibilities of configuration and advantages are specified in the subclaims.

Whereas the luminance of a long-afterglow and/or fluorescent marking is independent of the angle θ between the surface normal and the direction of view, and always has a constant value B_0, the light intensity dI varies with θ by contrast, and is proportional in the direction θ to cos θ, the point being that, when seen from the direction θ, the emitting surface dA' of the marking now exhibits only the apparent surface $dA' = dA \cos\theta$. This proportionality to $\cos\theta$ is denoted as Lambert's law:

(I) $dI(\theta) = B_0 dA' = B_0\, dA \cos\theta$

(II) $B_0 = dI(\theta)/dA \cos\theta$

The present invention now provides, as claimed in claim 1, a long-afterglow and/or fluorescent object which has at least one long-afterglow or fluorescent luminescent

material or a mixture of two or more thereof and emits light directionally, that is to say the light is emitted in a preferred direction, for example perpendicular to the surface of the light-emitting object.

In a preferred embodiment of the invention, the long-afterglow and/or fluorescent object is provided with an interference filter. It is possible with the aid of a suitable interference filter to achieve focusing of light in a preferred direction perpendicular to the light-emitting surface, and thus substantially to increase firstly the light intensity $dI(\theta)$ in this direction θ, and thus also the luminance B_0 in this direction.

The light is emitted at angles of between 0° and 180° to the emitting surface of the marking in the case of conventional long-afterglow and/or fluorescent safety markings. By appropriate arrangement of an interference filter at the emitting surface of the marking, the luminance can be enhanced at right angles to the surface by comparison with conventional long-afterglow and/or fluorescent safety markings. Owing to the interference filter, given an appropriate arrangement of the latter at the emitting surface of the marking, it is possible, on the one hand, for the angle θ at which light is emitted to be limited to a smaller angular range and, at the same time, for light which would otherwise have been emitted outside this angular range to be reflected into this limited angular range. The luminance B_0 of the surface is thereby substantially enhanced in this preferred direction θ.

There are no restrictions relating to the type of interference filter which can be used. In a preferred embodiment, the interference filter is present in the form of a film which is applied to the surface of the light-emitting object. This embodiment is advantageous

with reference to its production, because the application of a film can be carried out relatively quickly and easily. The interference filter can consist in this case of a combination of a plurality of films.

As an alternative thereto, the interference filter can also correspond to a layer vapor-deposited onto a suitable substrate, or to a plurality of vapor-deposited layers.

A further alternative constitutes an embodiment in which the backing layer itself represents an interference filter, for example when the luminescent material is printed onto the rear of the interference film with the aid of screen printing.

The long-afterglow and/or fluorescent object according to the invention has at least one luminescent material. The duration of the afterglow or of the fluorescence differs in length depending on the luminescent material selected.

The following may be named by way of example:

luminescent materials such as are described, for example, in Ullmanns Encyklopädie der Technischen Chemie [Ullmann's Encyclopedia of Technical Chemistry], 4th Edition, Volume 16, pages 179 ff. (1975), for example those based on sulfides such as, for example, CaS:Bi, CaSrS:Bi, ZnS:Cu and ZnCdS:Cu;

luminescent materials based on alkaline earth metal aluminates such as, for example, alkaline earth metal aluminates activated by europium or by lead, the alkaline earth metal being strontium or a mixture of strontium and calcium, as described, for example, in EP-A 0 094 132 and US 3,294,699 (Sr aluminate/ europium), alkaline earth metal aluminates likewise

activated by europium, with barium and strontium as alkaline earth metals, as described in DE-A 1 811 732;

luminescent materials comprising a matrix of the formula $M_{1-x}Al_2O_{4-x}$, M being at least one metal selected from among Ca, Sr and Ba, and X being a whole number not equal to 0, and the matrix containing Eu as activator and at least one of La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Mn, Sn and Bi as co-activator, as described in EP-A 0 710 709;

luminescent materials comprising a compound $MO \sim a(Al_{1-b}B_b)_2O_3:cR$, in which $0.5 \leq a \leq 10.0$, $0.0001 \leq b \leq 0.5$ and $0.0001 \leq c \leq 0.2$, MO representing at least one bivalent metal oxide, selected from MgO, CaO, SrO and ZnO, and R representing Eu and at least one additional rare earth element, as described in DE-A 195 21 119;

rare-earth-metal-doped alkaline earth metal aluminates as described in EP-A 0 710 709 and DE-A 195 21 119;

luminescent materials comprising a matrix having the formula MAl_2O_4, M being calcium, strontium or barium, and the matrix containing europium as activator and at least one of lanthanum, cerium, praeseodym, neodym, samarium, gadolinium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium, tin and bismuth as co-activator, as described in EP-B 0 622 440; ternary metal oxides activated by europium and containing SrO or BaO, or mixtures thereof, Al_2O_3 or a mixture of Al_2O_3 and Ga_2O_3 and ZnO or MgO, as described in US 4,216,408;

and luminescent materials containing at least one metal oxide selected from among MgO, CaO, SrO and ZnO, as well as Eu^{2+} as activator and at least one additional rare earth element, selected from among Pr, Nd, Dy and Tm, preferably Dy, as described in US 5,376,303.

It is preferred in this case to use luminescent materials based on an alkaline earth metal aluminate, in particular the luminescent materials described in EP-B 0 622 440, EP-A 0 710 709, DE-A 195 21 119 and US 5,376,303.

Use is preferably made here of luminescent materials based on $SrAl_2O_4$:Eu, Dy or ZnS:Cu luminescent materials. Mention may be made by way of example of those known in the trade by the trademark of "LUMILUX® long-afterglow pigments", specifically LUMILUX® Green SN-CR, LUMILUX® Green SN-C, LUMILUX® Green SN-FOG, LUMILUX® Green SN-F2, LUMILUX® Green SN-S, LUMILUX® Green N5, LUMILUX® Green N-PM, LUMILUX® Green N-N, LUMILUX® Green N2, LUMILUX® MB Green SN, LUMILUX® Green NM 33, or else those which are available under the designation of "LUMILUX® Effect Pigments", for example LUMILUX® Effect Blue N, LUMILUX® Blueish Green SN, LUMILUX® Blueish Green SN-F, LUMILUX® Effect Green N, LUMILUX® Effect Green N-L, LUMILUX® Effect Green N-E, LUMILUX® Effect Green N-F, LUMILUX® Effect Green N-FG, LUMILUX® Effect Green N-FF, LUMILUX® Effect Sipi F Yellow SN, LUMILUX® Effect Sipi Yellow, LUMILUX® Effect Sipi Red, LUMILUX® Effect Red N 100, and LUMILUX® Effect Red N 40.

However, it is also possible to use all other luminescent materials such as, for example, fluorescent materials which can be excited by UV, that is to say which are fluorescent. These include, for example, lamp luminescent materials which are available in the trade under the designation of "LUMILUX® Q pigments", specifically under the trade names of LUMILUX® Red QYV, LUMILUX® Red QYO, LUMILUX® Red QG, LUMILUX® Blue QCW. It is also possible to use inorganic coding pigments with the trademark of "LUMILUX® C pigments". These are, for example, under the trade names of LUMILUX® White CD 128, LUMILUX® Blue CD 164, LUMILUX® Blue CD 165, LUMILUX® Blue CD 162, LUMILUX® Blue CD 144, LUMILUX®

Green CD 140, LUMILUX® Green CD 112, LUMILUX® Green CD 111, LUMILUX® Green CD 1116, LUMILUX® Green CD 117, LUMILUX® Green CD 145, LUMILUX® Green CD 163, LUMILUX® Green CD 166, LUMILUX® Turquoise CD 167, LUMILUX® Red CD 110, LUMILUX® Yellowish Orange CD 135, LUMILUX® Yellowish Orange CD 130, LUMILUX® Red CD 168, LUMILUX® Red CD 120, LUMILUX® Red CD 141, LUMILUX® Red CD 105, LUMILUX® Red CD 106.

The quantity of the luminescent material used is not limited in any particular way. The coverage in the case of ZnS luminescent materials is preferably in a range from 300 g/m^2 to 400 g/m^2, and in the case of luminescent materials based on $SrAl_2O_4$ in a range from 30 g/m^2 to 300 g/m^2.

After removal of the exciting source, a dark-adapted eye can preferably still detect the afterglow after 20 hours.

In a further preferred embodiment, the object according to the invention has at least the following elements:

a) a backing layer,

b) at least one long-afterglow and/or fluorescent layer arranged over the backing layer, and

c) at least one interference filter arranged over the long-afterglow and/or fluorescent layer.

In a preferred embodiment, the interference filter is transparent to green light irradiated perpendicular and virtually perpendicular to the filter, whereas light which falls onto the interference filter at another angle is reflected by the interference filter. It is also possible to use a non-green luminescent material. The light which is thus emitted in the direction of the interference filter by the at least one long-afterglow

and/or fluorescent layer arranged over the backing layer passes the filter only if it strikes the filter at an angle of 90° or only slightly differing therefrom. Light beams which impinge on the interference filter at a substantially smaller angle are reflected by the filter and fall back again onto the long-afterglow and/or fluorescent layer. A plurality of possibilities exist for the reflected light beams. For example, they can be absorbed by a luminescent material particle and be reemitted later by this luminescent material particle, or else the light beams strike a second crystal and are reflected by this directly in the direction of the interference filter. Finally, however, it is also possible for there to be multiple reflection of the light beams inside the long-afterglow and/or fluorescent layer. The result of this for the light beams retroreflected by the interference filter is that after renewed absorption inside the long-afterglow and/or fluorescent layer, and/or after the renewed reflection inside this layer, they can be reemitted in the direction of the interference filter. The luminance perpendicular to the interference filter is thereby increased, and the laterally emitted light intensity is simultaneously reduced. Consequently, with the aid of the interference filter the luminance which can be observed perpendicular to the interference filter is increased to the detriment of the luminance which can be observed laterally relative to the interference filter.

In a preferred embodiment of the invention, in addition to the layers set forth above, the object according to the invention also has further layers, for example a UV protective layer or a protective layer for reducing the flammability. A diffusely reflecting layer is preferably also located between the backing layer and the luminescent layer. This ensures that no light beam emitted by the long-afterglow and/or fluorescent layer in a direction opposite to the direction of the

interference filter is lost, but is at least retroreflected again into the long-afterglow or fluorescent layer, and is therefore capable of being emitted in the direction of the interference filter, be this by direct passage through the long-afterglow and/or fluorescent layer or by further absorption followed by subsequent reemission, or by single or multiple reflection inside the long-afterglow and/or fluorescent layer.

In a further preferred embodiment of the invention, the backing layer itself consists of a diffusely reflecting, white material. It is preferred here to use a coated metal sheet or a metal foil. It is particularly preferred to select aluminum, but it is also possible to use other metals. Furthermore, the backing layer, preferably the metal sheet, can have a further layer comprising an enamel. Enamel serves in this case as embedding material for the luminescent material particles.

As already indicated, the long-afterglow and/or fluorescent layer has at least one phosphorescent luminescent material.

In a further embodiment of the invention, the substrate is made from glass, quartz glass or a transparent polymer, and the fluorescent layer comprises a UV luminescent material. In this case, UV radiation is preferably irradiated onto the fluorescent layer from behind, that is to say through the transparent substrate.

In another preferred embodiment of the object according to the invention, in addition to the phosphorescent or fluorescent luminescent material, the long-afterglow and/or fluorescent layer containing the at least one luminescent material has further substances such as binders or fillers, for example. Use is made here, for

example, of polymers such as, for example, PVC, white pigments such as TiO_2, UV absorbers, flame-retardant means and/or screen printing binders.

Furthermore, the invention also relates to the use of the object according to the invention as a safety marking. The long afterglow and/or the fluorescence and the enhanced luminance in a preferred direction of the object according to the invention offers substantial advantages in the marking of escape routes, in order to render these still detectable even in the case of the failure of light.

There are no limitations with reference to the shape of the object according to the invention, nor to that of the safety marking according to the invention, that is to say they can be present, for example, in the form of boards of different thickness and with different edge lengths. Moreover, a safety marking according to the invention and/or an object according to the invention can also include additional overprints with a non-phosphorescent color.

Furthermore, the invention also relates to a method for enhancing the luminance of a long-afterglow and/or fluorescent object, the method having at least the following step:

a) arranging at least one interference filter on the long-afterglow and/or fluorescent object.

The invention is now to be explained in more detail with the aid of the following examples in conjunction with figures 1 to 3 and table 1. In the drawings:

Figure 1 shows a schematic of an embodiment of an object according to the invention;

Figure 2 shows the plot of the afterglow density in mcd/m^2 of examples 1 (continuous line) and 2 (dotted line) against time in minutes; and

Figure 3 shows the plot of the afterglow density in mcd/m^2 of examples 3 (continuous line) and 4 (dotted line) against time in minutes.

Figure 1 shows a schematic of an embodiment of an object according to the invention and/or of a safety marking according to the invention. In the present embodiment, the object G according to the invention has three layers A, B and C. Layer A constitutes the backing layer in this case. As mentioned above, in a preferred embodiment this backing layer A consists of a diffusely reflecting material. It can be prevented in this way that any light beam emitted by the long-afterglow and/or fluorescent layer B, or passing the latter, is absorbed in the backing layer A and is thereby lost. A long-afterglow and/or fluorescent layer B having luminescent crystals B', which emits light in the direction of the interference filter C, is applied to this backing layer A. The light which strikes the interference filter at an angle of 90° or only slightly different therefrom can pass the interference filter, for example the light beams 2 to 4 which are illustrated here. Light beams which impinge on the interference filter at a very much smaller angle than 90°, for example the beams 6 and 7, are, in contrast, reflected at the interference filter, and so once again strike the long-afterglow and/or fluorescent layer B. There are a plurality of possibilities for the further course of these reflected light beams. On the one hand, they can be absorbed by a luminescent material particle B' and be reemitted later by the latter, or they are reflected directly in the direction of the interference filter C by a second luminescent material crystal B'. Moreover, it is also possible for there to be multiple reflection inside the long-afterglow and/or fluorescent

layer B. The reflected light beams are therefore not lost, but are capable of being reemitted in the direction of the interference filter C after renewed absorption and subsequent emission or after repeated reflection. Depending on the angle at which they then strike the interference filter C, they can then either pass to the latter without hindrance, or else they are retroreflected again in the direction of the long-afterglow and/or fluorescent layer B. The result is that the luminance perpendicular to the interference filter C is increased, and the intensity of the laterally emitted light is simultaneously reduced.

Examples

Example 1

In example 1, a plate of polyvinyl chloride, coated with a long-afterglow and/or fluorescent zinc sulfide doped with copper, was provided with a commercially available interference film (Optical Lighting Film from 3M) and measured in lighting terms, that is to say the luminance was determined in mcd/m^2 after a time of varying length. The results obtained in this case are shown in figure 2 as a continuous line, and in row 1 of table 1.

Example 2

In example 2, the long-afterglow and/or fluorescent plate originating from example 2 was measured, likewise in lighting terms, in a similar way to example 1 without an interference filter for the purpose of comparison, and this is illustrated in figure 2 as a dotted line, and in row 2 of table 1.

Example 3

In example 3, an aluminum plate coated with strontium aluminate doped with europium and dysprosium was provided with an interference filter (Optical Lighting Film from 3M) and measured, likewise in lighting terms, in a way analogous to examples 1 and 2. The results obtained are illustrated in figure 3 as a continuous line, and in row 3 of table 1.

Example 4

For comparative purposes, the long-afterglow and/or fluorescent plate of example 3 was, in turn, measured in lighting terms without an interference filter.

Example 5

In example 5, a polyvinyl chloride plate coated with long-afterglow and/or fluorescent zinc sulfide doped with copper was provided with a commercially available interference film (Brightness Enhancement Film from 3M, type BEF II 100/31) and measured in lighting terms, that is to say the luminance was determined in mcd/m^2 after a time of varying length. The results are shown in row 5 of table 1.

Example 6

In example 6, a polyvinyl chloride plate coated with long-afterglow and/or fluorescent zinc sulfide doped with copper was provided with a commercially available interference film (Brightness Enhancement Film from 3M, type BEF II 90/50) and measured in lighting terms, that is to say the luminance was determined in mcd/m^2 after a time of varying length. The results are shown in row 6 of table 1.

Example 7

In example 7, a polyvinyl chloride plate coated with long-afterglow and/or fluorescent zinc sulfide doped with copper was provided with a commercially available interference film (Brightness Enhancement Film from 3M, type TRAF II) and measured in lighting terms, that is to say the luminance was determined in mcd/m^2 after a time of varying length. The results are shown in row 7 of table 1.

Example 8

The long-afterglow and/or fluorescent plate of examples 5 to 7 was measured in lighting terms without an interference filter for comparative purposes.

Example 9

In example 9, an aluminum plate coated with long-afterglow and/or fluorescent strontium aluminate doped with europium and dysprosium was provided with a commercially available interference film (Brightness Enhancement Film from 3M, type BEF II 100/31) and measured in lighting terms, that is to say the luminacne was determined in mcd/m^2 after a time of varying length. The results are shown in row 9 of table 1.

Example 10

In example 10, an aluminum plate coated with long-afterglow and/or fluorescent strontium aluminate doped with europium and dysprosium was provided with a commercially available interference film (Brightness Enhancement Film from 3M, type BEF II 90/50) and measured in lighting terms, that is to say the luminance was determined in mcd/m^2 after a time of

varying length. The results are shown in row 10 of table 1.

Example 11

In example 11, an aluminum plate coated with long-afterglow and/or fluorescent strontium aluminate doped with europium and dysprosium was provided with a commercially available interference film (Brightness Enhancement Film from 3M, type TRAF II) and measured in lighting terms, that is to say the luminance was determined in mcd/m^2 after a time of varying length. The results are shown in row 11 of table 1.

Example 12

The long-afterglow and/or fluorescent plate of examples 9 to 11 was measured in lighting terms without an interference filter for comparative purposes.

Example 13

In example 13, the long-afterglow and/or fluorescent plate of example 5 was measured in lighting terms at an angle of 60°.

Example 14

In example 14, the long-afterglow and/or fluorescent plate of example 6 was measured in lighting terms at an angle of 60°.

Example 15

In example 15, the long-afterglow and/or fluorescent plate of example 7 was measured in lighting terms at an angle of 60°.

Example 16

In example 16, the long-afterglow and/or fluorescent plate of example 8 was measured in lighting terms at an angle of 60°.

Example 17

In example 17, the long-afterglow and/or fluorescent plate of example 9 was measured in lighting terms at an angle of 60°.

Example 18

In example 18, the long-afterglow and/or fluorescent plate of example 10 was measured in lighting terms at an angle of 60°.

Example 19

In example 19, the long-afterglow and/or fluorescent plate of example 11 was measured in lighting terms at an angle of 60°.

Example 20

In example 20, the long-afterglow and/or fluorescent plate of example 12 was measured in lighting terms at an angle of 60°.

It may be remarked that the luminance shown in table 1 and in figures 2 and 3 was determined in accordance with DIN 67510 Part 1.

Table 1

Luminance in mcd/m^2

Example No.	After 1 min.	After 5 min.	After 10 min.	After 60 min.	After 120 min.
1	309.0	68.4	33.7	4.63	2.04
2*	262.0	58.7	28.7	4.0	1.74
3	3580.0	825.0	415.0	61.0	27.5
4*	2700.0	650.0	325.0	46.4	20.9
5	309	69.4	34.3	4.81	2.13
6	326	72.8	35.9	4.93	2.15
7	274	64.4	32.1	4.55	2.01
8*	266	57.8	28.2	3.77	1.6
9	3730	907	456	64.8	29.1
10	3960	973	487	69.4	31.2
11	3400	822	414	59.1	26.1
12*	2710	653	326	46.0	20.4
13	311	68.6	33.7	4.72	2.08
14	314	69.7	34.4	4.77	2.08
15	280	61.4	30.0	4.13	1.77
16*	259	56.7	27.8	3.9	1.68
17	3520	862	432	61.4	27.5
18	3660	890	447	65.1	29.3
19	3150	748	373	52.7	23.3
20*	2680	651	324	45.3	19.9

* Reference material without interference filter

Patent Claims

1. A long-afterglow and/or fluorescent object which emits light directionally and has at least one long-afterglow or fluorescent luminescent material or a mixture of two or more thereof.

2. The object as claimed in claim 1, characterized in that the object is provided with at least one interference filter.

3. The object as claimed in claim 1 or 2, characterized in that the interference filter is present in the form of a film or a vapor-deposited layer.

4. The object as claimed in one of the preceding claims, characterized in that the object has at least the following elements:

a) a backing layer,

b) at least one long-afterglow and/or fluorescent layer arranged over the backing layer, and

c) at least one interference filter arranged over the long-afterglow and/or fluorescent layer.

5. The object as claimed in claim 5, wherein the at least one long-afterglow and/or fluorescent layer arranged over the backing layer has at least one luminescent material.

6. The object as claimed in claim 5 or 6, characterized in that a diffusely reflecting layer is arranged between the backing layer and the at least one long-afterglow and/or fluorescent layer arranged over the backing layer.

7. The object as claimed in one of claims 5 or 6, characterized in that the backing layer is diffusely reflecting.

8. The use of an object as claimed in one of claims 1 to 7 as a safety marking.

9. A method for enhancing the luminance of a long-afterglow and/or fluorescent object, the method having at least the following step:

a) arranging at least one interference filter on the long-afterglow and/or fluorescent object.

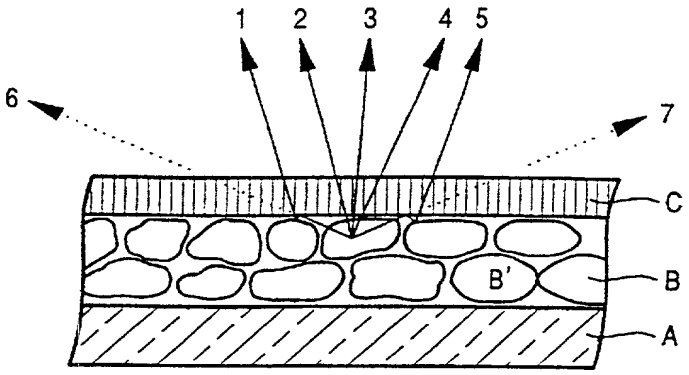

Fig. 1

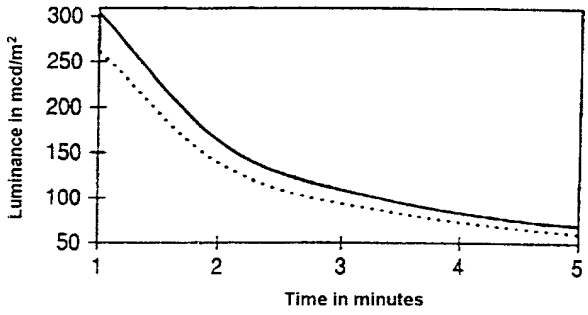

Fig. 2

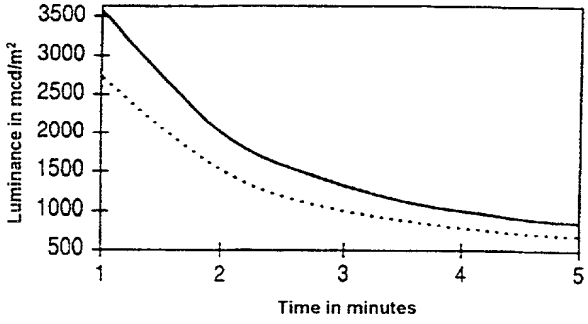

Fig. 3

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I HEREBY DECLARE:

THAT my residence, post office address, and citizenship are as stated below next to my name;

THAT I believe I am the original, first, and sole inventor (if only one inventor is named below) or an original, first, and joint inventor (if plural inventors are named below or in an attached Declaration) of the subject matter which is claimed and for which a patent is sought on the invention entitled

ENHANCING THE LUMINANCE OF LONGTIME LUMINESCENT AND/OR FLUORESCENT SURFACES

(Attorney Docket No. 016779-0164)

the specification of which (check one)

___ is attached hereto.

_X_ was filed on June 6, 2000 as United States Application Number or PCT International Application Number PCT/EP00/05180 and was amended on _____ (if applicable).

THAT I do not know and do not believe that the same invention was ever known or used by others in the United States of America, or was patented or described in any printed publication in any country, before I (we) invented it;

THAT I do not know and do not believe that the same invention was patented or described in any printed publication in any country, or in public use or on sale in the United States of America, for more than one year prior to the filing date of this United States application;

THAT I do not know and do not believe that the same invention was first patented or made the subject of an inventor's certificate that issued in any country foreign to the United States of America before the filing date of this United States application if the foreign application was filed by me (us), or by my (our) legal representatives or assigns, more than twelve months (six months for design patents) prior to the filing date of this United States application;

THAT I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment specifically referred to above;

THAT I believe that the above-identified specification contains a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention, and sets forth the best mode contemplated by me of carrying out the invention; and

THAT I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I HEREBY CLAIM foreign priority benefits under Title 35, United States Code §119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number	Country	Foreign Filing Date	Priority Claimed?	Certified Copy Attached?
199 26 980.7 ✓	Federal Republic of Germany ✓	June 14, 1999 ✓	YES	

I HEREBY CLAIM the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

U.S. Provisional Application Number	Filing Date

I HEREBY CLAIM the benefit under Title 35, United States Code, §120 of any United States application(s), or § 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Application Number	Parent Filing Date	Parent Patent Number

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I UNDERSTAND AND AGREE THAT the foregoing attorneys and agents appointed by me to prosecute this application do not personally represent me or my legal interests, but instead represent the interests of the legal owner(s) of the invention described in this application.

I FURTHER DECLARE THAT all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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